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Sarah Edmondson

*Te Amorangi Mātauranga Matua*, [sarah.edmonson@tec.govt.nz](mailto:sarah.edmonson@tec.govt.nz)

Yi-Te Chiu

*Victoria University of Wellington*, [yi-te.chiu@vuw.ac.nz](mailto:yi-te.chiu@vuw.ac.nz)

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# Exploring the Impact of Mental Models on Scrum Outcomes: Insights from Scrum Teams in New Zealand Government

Completed research paper

## **Sarah Edmonson**

Te Amorangi Mātauranga Matua – Tertiary Education Commission, New Zealand  
Email: Sarah.Edmonson@tec.govt.nz

## **Yi-Te Chiu**

Wellington School of Business and Government  
Te Herenga Waka—Victoria University of Wellington  
Email: yi-te.chiu@vuw.ac.nz

## **Abstract**

The impact of product owner, Scrum master and developer mental models on Scrum teams has been investigated in this research. Twelve semi-structured interviews with practitioners from three Scrum teams in New Zealand government indicated that the product owner mental model is crucial for positive Scrum outcomes. A complementary mental model between the product owner and the development team appears to drive the highest client and team satisfaction. Across all participants, Customer- and Team-oriented mental models coincided with the highest levels of client and team satisfaction. This preliminary evidence shows that mental models can contribute to positive Scrum outcomes. It sheds new light on how Scrum can be effectively managed in the public sector by considering individual mental models and team mental models. The mental model perspective offers organisations a different way to evaluate the operation of Scrum teams.

**Keywords:** Scrum, Team mental models, Agile methodology, IS team

# 1 Introduction

Scrum is an Agile approach that has continued to develop a foundation of support in both research and practice (Abrahamsson et al. 2010; Moe et al. 2010; Schwaber and Beedle 2002; Yu and Petter 2014), because it brings efficiency and value to organisations and clients, if implemented properly (Ozierańska et al. 2016). In New Zealand, the government has a strong appetite to deliver Scrum projects (New Zealand Government 2013). The government strives to be flexible and agile in implementing digital technologies to respond to changing circumstances while delivering value to the public. It is also hoped that incorporating Agile approaches into information systems development (ISD) can enhance communication and transparency to prevent notorious Information Systems (IS) project failures in the public sector, such as Novopay payroll system in New Zealand (Mayhew et al. 2013) and Queensland Health Payroll System in Australia (Eden and Sedera 2014).

Despite the widespread adoption of Scrum in private organisations, Scrum project delivery is slow in public organisations. Among others, the involvement of multiple stakeholders across organisations along with hierarchical organisational culture and structure cause difficulties (Nuottila et al. 2016). Such situational factors show strong influences on the attitudes and behaviours of people who work in the environment (Chow and Cao 2008).

In contrast to prior research focusing on investigating changes in governance, culture, and structure to successfully implement Scrum, this paper takes a bottom-up approach and investigates individual mental models that contribute to Scrum outcomes. Our mental models “determine how we take action” (Senge 1990) and can predict decisions and behaviour (Rouse et al. 1992). The project team’s behaviour has a direct impact on the outcomes of a project; thus, an understanding of the associated mental models for Scrum operations could be of particular use. A better understanding of individual mental models may help further research on changes in mindset, thereby eventually affecting organisational culture and structure (House et al. 1995). Existing literature does not reveal the specific mental models that drive positive Scrum outcomes. This research study aims to understand a mental model related to Scrum outcomes and then investigate how interplays of mental models among Scrum project members influence positive Scrum outcomes. The following research questions guide our inquiry: What are Scrum team members’ mental models? How do individual mental models and team mental models contribute to positive Scrum outcomes?

The research population for this project was limited to the New Zealand public sector. The research sample was practitioners who had recently been engaged in New Zealand public sector IS Development (ISD) Scrum projects. This approach was taken because, over time, memory can distort; thus, participants were selected based on having recent examples to draw upon in their responses. It is also possible that Scrum practices have evolved over the past years in New Zealand. Using recent project examples provides comparability across respondents.

In the following pages, we first provide a brief introduction on Scrum, Scrum success, and mental models related to Scrum. Next, we describe research design and analysis procedures. Finally, we discuss results and implications.

## 2 Literature Review

### 2.1 Scrum

‘Scrum’ is a project delivery approach, primarily used for software development. It is focused on enabling self-managing teams to design and deliver software solutions iteratively, in short, time-boxed periods called ‘sprints’ (Schwaber and Beedle 2002). The intent of Scrum is to frequently deliver value to customers in the form of working software. At the end of each sprint, new or updated software is delivered to the customer. There are only three formal roles in a Scrum team:

1. A Product Owner, who provides the sole voice of the customer on the project. The Product Owner is responsible for working with relevant stakeholders and customers to decide and prioritise what the team will deliver.
2. A Scrum Master, who focuses on ensuring the team has what they need to deliver, and helps to remove any roadblocks preventing progress.
3. The Development Team, who are responsible for delivering software that meets the Product Owner’s requirements.

In ISD, Scrum is “a simple low overhead process for managing and tracking software development” (Fitzgerald et al. 2006) that seeks to avoid spending effort on activities that add little value (Highsmith 1999). Prior to Scrum being adopted within the ISD realm, in the mid-1980s Takeuchi and Nonaka (1986) proposed “the rugby approach” to product development. This approach was posited to be “essential for companies seeking to develop new products quickly and flexibly” (Takeuchi and Nonaka 1986) and was a forerunner to the development of Scrum in ISD, proposed and championed by Sutherland and Schwaber (1995).

In 2001, Scrum was included as one of the formal agile methods (Williams 2012). Scrum is recommended for ISD projects where there is a strong need for flexibility and adaptability (Abrahamsson et al. 2010; Schwaber and Beedle 2002), and in situations with “constant change and evolving complexity” (Lycett and Paul 1999).

In the context of this research, Scrum is applicable to New Zealand public sector ISD projects with rapidly changing requirements or where the available technology channels and platforms continue to evolve rapidly. The New Zealand government’s ICT Action Plan to 2017 has a strong focus on the delivery of customer-facing digital services. These are particularly suitable for the agile method because of the need to cope with changing technological opportunities, and the corresponding expectations from citizens for improved government digital services

## **2.2 Scrum Performance**

Drawing on Aladwani’s (2002) integrated performance model for IS projects, IS project performance can be classified into three dimensions: task, psychological, and organisational. Task outcomes consist of task efficiency and task effectiveness. Gemino et al. (2007) refer task efficiency to process performance and task effectiveness to product performance. Specifically, process performance considers adherences to costs and time estimates while product performance is concerned with product quality and the ability to meet project scope. In the Agile context, Maruping et al. (2009) show that, under proper outcome and self-control, the eXtreme Programming (XP) method improves product quality. Chow and Cao’s (2008) review on what contributes to Agile performance also laid an emphasis on cost, time, quality, and scope. Psychological outcomes refer to project members’ satisfaction. As stated in the Agile Manifesto, individuals and interactions are more valuable than processes and tools (Beck et al. 2001). It is suggested to “build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done”. Accordingly, project members’ satisfaction is an indispensable component of Agile performance. Scrum practices, such as daily standup and retrospective meetings, encourage team communication and coordination and lead to better psychological outcomes (Moe et al. 2010). Organisational outcomes take value creation into consideration. The Agile Manifesto indicates the importance of business value delivered by IS through value co-creation with customers and reliance on constant delivery of working software.

Although literature has shown that project performance is a multidimensional construct (Aladwani 2002; Cooke-Davies 2002), task outcomes remain the primary criteria to measure project performance even when an Agile approach is introduced. The tendency to use task outcomes may be attributed to these being relatively objective, and are required to be reported by project managers to organisations. The goals of Agile are supposed to bring value to organisations and bring value to stakeholders. Serrador and Pinto (2015) suggested the addition of stakeholders’ evaluation of project performance to cover expectations of different stakeholders. When considering Scrum performance, we should look beyond task outcomes and pay more attention to psychological and organisational outcomes. This study aims to understand how to improve Scrum delivery. Instead of evaluating these individual project management dimensions, we elicited Scrum members’ views on Scrum delivery. The Scrum master, product owner, and the development team therefore reflected multiple dimensions of Scrum outcomes.

## **2.3 Mental Models and ISD Projects**

Mental model is a fundamental driver of people’s thoughts and behaviour. That is, “our mental models determine not only what sense we make of the world, but how we take action.” (Senge 1990) Senge’s interpretation is one of many: The ‘mental model’ construct is ubiquitous across social science disciplines but does not have a clear universal definition (Rouse and Morris 1986). Mental models can be described as having two primary facets: knowledge and beliefs (Rouse et al. 1992). Knowledge refers to an individual, dyad or team-level understanding, at a surface or superficial level, and beliefs reflect people’s underlying values and paradigms. Together, these can be used to predict behaviour for the setting in question.

Of much interest to this research is the knowledge aspect of Scrum project professionals' mental models. Andres (2012) observed that most researchers define mental models as "task-related and team-related knowledge". Taking one of the definitions as an expanded example, Fiore et al. (2001) define team mental model as "knowledge structures held by members of a team that enable them to form accurate explanations and expectations for the task, and in turn, to coordinate their actions and adapt their behaviour to demands of the task and other team members." This specifically illustrates the relationship between knowledge structures and behaviour. In associated research about team mental models, Rentsch and Zelno (2005) use the term 'team cognition', which MacMillan, Entin and Serfaty (2002) describe as the way information is processed and used. We will retain the use of 'mental model' for the sake of clarity. In the context of ISD project management, while practitioners suggest an important role of mental models (McDonald 2015), limited research has investigated its implications (Miler and Gaida 2019; Mordi and Schoop 2020). A dearth of research hinders the development of strategies and practices for shaping and influencing project members' attitudes and behaviours in projects.

We adopt the ISD project mental model proposed by Chiu and Staples (2012) as the basis for mental model analysis in this project. This is because the ISD project mental model is directly related to ISD projects. The ISD project mental model suggests four mental model orientations: Team, Customer, Enterprise and Product. A number of ISD project concepts are stored in practitioners' minds, substantiating each mental model orientation.

Team-oriented mental model emphasises the interaction among project members. People who possess this mental model orientations embrace concepts such as close collaboration, intensive communication, management of sponsors and champions, and team and culture building.

Enterprise-oriented mental model focuses not only low-level project process management, but also enterprise-wide management of projects. Individuals who hold this mental model orientation aim to explore outside the context of a given project. They value resource integration and process standardisation, with the goal of improving strategic business value. They believe in concepts such as control of software development processes, development of IS professionals' competencies, the use of tools and software to support projects, alignment between projects and IT/business strategy.

Product-oriented mental model focuses on the development of highly adaptable software that can withstand a volatile external environment. Refactoring suggested by eXtreme Programming aiming to enhance product quality can be considered as one of representative concepts. Use of design standards, regular inspection and review of codes, code reuse, and test-driven development are all relevant to Product-oriented mental model.

Customer-oriented mental model, while is concerned with people similar to Team-oriented mental model, places a strong emphasis on business value brought both by and to the customer. Continuance attention to customer needs, user involvement and participation, collective ownership between team members and clients, frequent releases to customers are significant underlying concepts.

The Agile manifesto values open project environments and people-oriented development, so we could expect mental models for Scrum-focused practitioners to lean towards Customer mental model and Team mental model. It would be unusual for a practitioner to have one mental model orientation. Instead, people are likely to have a dominant mental model in one type and less mental model orientations in the other.

## **2.4 Team Mental Models and ISD Projects**

Prior research indicates that shared team mental models lead to greater levels of team success, because teams do not need to divert energy into conflict arising from dissimilar mental models (Rentsch and Zelno 2005). There is limited research about mental models when applied to the Scrum method. Moe et al. (2010) and Yu and Petter (2014) have delved into this area to some extent. Schmidt et al.'s (2014) investigation into the impact of shared mental models on agile ISD projects, using a survey instrument, however, this research did not analyse mental models of specific Agile roles. Moe et al. (2010) used an exploratory case study approach to investigate teamwork in an organisation that had recently introduced Scrum, and found that trust and shared mental models are of fundamental importance in driving project performance or failure. As with Schmidt et al. (2014), the research developed by Moe et al. (2010) contributed to theory in terms of team-level mental models on agile projects, but did not investigate the mental models of specific Scrum roles, for example, a comparison of product owner mental models against the Scrum development team.

Several researchers have found that that shared team mental models about teamwork positively impact team success (Lu et al. 2011; McComb and Kennedy 2013). Shared mental models about teamwork and the particular task at hand contribute to software project performance (Hsu et al. 2011). Anders (2012) provides an example of this in his research. His investigation related to technology-mediated collaboration, and focused on mental models as being task-related knowledge. He also uses the concept of shared team mental models, that is, shared team understanding, when referring to mental models for task-related team situations (Andres 2012). He, too, noted that the stronger the shared mental model, the greater the team's success on completing the task set for the team.

### 3 Methodology

This research project followed a qualitative approach, using semi-structured interviews with Agile practitioners. This approach was selected because the ISD project mental model is a new concept that has not previously been used to assess and compare the mix of mental models within a single team. Rich data was necessary to support the exploratory nature of this research and build a basis for further research.

The research stages were: (1) Literature review, (2) Interview protocol design and testing, (3) Semi-structured one on one interviews, (4) Deductive coding for card sorting exercise, using the ISD project mental model (Chiu and Staples 2012), (5) Deductive coding of rich interview data, including individual mental models, team mental models, and Scrum outcomes, and (6) member checking of interview transcripts to confirm participants were comfortable with their statements, and one on one follow up meeting to discuss and review participants' mental models.

#### 3.1 Research Participants

The interview participants were sought from the New Zealand Government Agile Connect forum, the researcher's personal networks, and referrals. We contacted 6 Scrum teams. A total of 16 participants were interviewed in September and October 2016. All interviews were held in person, one on one with the interviewer. Three Scrum teams are the focus in this research because the majority of the team members in each team were interviewed. We did not throw away data from other interviews. Instead, we used them to complement our analysis as they provided additional insight into mental models and Scrum outcomes. The three teams that formed the basis of this research all delivered New Zealand government software projects during 2015 and 2016. Teams A and C are from the same organisation and share a common Scrum Master. Team B is from a different organisation. Self-reported information about each project was reported consistently for each team, and is summarised in Table 1.

	<b>Team A</b>	<b>Team B</b>	<b>Team C</b>
<b>Type of application</b>	Business intelligence reporting application	Mobile data application	Business intelligence reporting application
<b>Project duration</b>	4 months	12 months	6 months
<b>Sprint length</b>	3 weeks	2 weeks	3 weeks
<b>Team size</b>	4 (All participated)	5 (4 participated)	5 (4 participated)
<b>Average development team IT experience</b>	10-15 years	8-25 years	10-15 years
<b>Level of team Scrum experience</b>	~12 months	~12 months	6-12 months
<b>Formal Scrum training received</b>	All team members	Some team members	Some team members
<b>Number of end-users of the application</b>	200 end users	350 end users	200 end users

*Table 1 Team Characteristics*

### 3.2 Data Gathering and Analysis

The semi-structured interview protocol was designed to focus only on sprints that each participant had been involved with during the previous year. Participants were asked to choose their most recent or most memorable Scrum, their most successful Scrum, and their least successful Scrum. Participants described each Scrum, and discussed what was different between what they considered to be their most successful and least successful Scrum. Participants were prompted to discuss less successful Scrum to reduce social desirability bias; that is, self-moderated answers based on the need to present oneself in a favourable light (Podsakoff et al. 2003). Participants were also asked to explain what effective Scrum outcomes meant to them, instead of using a pre-defined set of measures (pre-defined measures are used later – refer to “Follow-up verification” in this section). This approach was intentional. The aim was to unearth as much insight into participant mental models as possible. A participant’s perspective of what a ‘successful’ Scrum looks like can provide an indicator of their mental model based on the aspects of Scrum that they feel are important.

**Card Sorting Exercise:** The last step in the interview protocol was a card sorting exercise, where participants were asked to identify the factors that they felt were most important to achieve a successful Scrum. Participants wrote each factor down on a separate card, in their own words. Participants were able to add as few or as many cards as they wanted, until they felt they had achieved coverage of the major contributing factors to Scrum success. Once participants had written down the factors that they felt contributed to Scrum success, sorted the cards from the most important or influential contributor to the least important or influential contributor.

Responses to the card sorting exercise were used to identify a potential mental model orientation for each participant. To do this, two coders independently reviewed the cards and the transcribed participant explanations. Each coder coded each card under one of the four ISD project mental model orientations. Coding is in accordance with the process of identifying key concepts in mental models (Jankowicz 2004). For example, cards that had been coded as “continuous attention to customer problems and satisfaction” and “user involvement and participation” were noted as “Customer” mental model orientation; “close collaboration and communication between project members during development” and “empowerment” were categorised as “Team” mental model orientation; “continuous integration” and “reuse of code and components” were considered as “Product” mental model orientation; “Identify IT/business strategy and align projects with IT/business strategy” and “develop capabilities of IS development professionals” were considered as “Enterprise” mental model orientation. The coders then met and compared coding results. The coders agreed to a chosen ISD project mental model orientations.

To determine the initial mental model allocation for each participant, we used a spreadsheet to list each participant, and the number of “Team”, “Customer”, “Product” and “Enterprise” cards they had selected. The score for each mental model type was based on the average rating given to each card during the card sorting exercise. This provided a rough indication of each participant’s dominant and secondary mental model orientations.

**Data Interpretation:** Deductive coding for the card sorting exercise from the previous step offers an early indication of participants’ possible mental models. We then further conducted a deductive coding for the full interview rich data following the thematic analysis (Saldaña 2015). We first summarised each interview in the participants’ own words to provide a summarised view of the areas that participants focused on. We then analysed the data, leveraging existing frameworks, specifically, the ISD project mental model, to verify individuals’ mental model orientations. We also assess how each participant evaluated Scrum outcomes, including operational efficiency and satisfaction of Scrum masters, project team members, and product owner.

**Follow-up Verification:** After analysis, participants were asked follow-up questions using the existing set of Agile success factors by Serrador & Pinto (2015) and Jugdev & Müller (2005) via email. We also conducted a 20-minute meeting for each participant to confirm the interview results. During the follow-up discussion, the researcher asked how accurate the participants felt their mental model assessments were. Participants were also asked whether they felt the findings of the research made sense to them based on their own experiences, and were given an opportunity to add final thoughts about the relationship between mental models and Scrum outcomes, based on their experiences.

## 4 Results and Discussion

### 4.1 ISD project mental models, and team and client evaluation on Scrum project outcomes

Participants exhibited a range of mental models, but the two most common mental models were Customer and Team. This is not surprising, considering that the fundamental Agile values focus on ‘people’ factors (Beck et al. 2001). Table 2 summarises the mental models for each team respondent, and the self-reported Scrum evaluation, mainly the satisfaction about Scrum outcomes, for each team. The same Scrum master was responsible for both Team A and Team C.

Team	Product owner mental model orientations	Scrum master mental model orientations	Team members’ mental model orientations	Client evaluation on Scrum project outcomes (product owner)	Team evaluation on Scrum project outcomes (all others)
A	1: Team 2: Customer	1: Customer 2: Team	1: Customer 2: Team (both team members)	High (6/7)	High (6.6/7)
B	1: Customer 2: Team	1: Customer 2: Team	1: Team 2: Customer (both team members)	High (6/7)	Medium (5.3/7)
C	1: Enterprise 2: Team	1: Customer 2: Team	Member A – 1: Team 2: Enterprise; Member B – 1: Customer 2: Team	Medium (5/7)	Low (3.3/7)

*Note. Numbers in the cells of mental model: 1 denotes the primary mental model orientation, and 2 denotes the secondary mental model.*

*Table 2 Participant ISDP mental models and self-reported client and team satisfaction*

Both Scrum masters had the same mental model, primarily Customer, with Team as the secondary mental model. The three product owners had different mental models from each other, although Team featured in all three. The development team member mental models varied across the teams, but, as with the product owners, the Team mental model featured for all participants.

The team evaluation columns are based on the interview question about how the participants felt the outcomes of their Scrum operations. This was verified by the follow-up questionnaire where participants were asked to provide quantitative ratings about their Scrum project outcomes. These are the marks for the question, “How do you rate your own satisfaction with Scrum project outcomes?”.

The number shown in the client evaluation column reflects the product owner’s assessment out of a maximum of 7. The number shown in the team satisfaction column reflects the average response from the Scrum master and team members. A satisfaction rating of “High” (6 to 7) corresponded with strongly positive statements about self-reported success during interviews. A “Medium” rating (4 to 5) corresponded with feelings of success, with less enthusiastic language. A mark of less than 4 appeared to correspond with negative feedback about success.

In the cases of Teams B and C, the self-rated satisfaction from the product owner and the team members differed. Particularly, in team C, the product owner felt the project was successful and was satisfied with the outcome, but the project team were not. This cannot be considered a complete success based on team feedback, but should be considered a success based on product owner feedback.

Team A achieved high self-reported positive evaluation for both the product owner and the development team members. The Scrum master and development team members all held a primary ISD project mental model of Customer, and a secondary ISD project mental model of Team. Conversely, the Team A product owner’s primary ISD project mental model was Team, followed by Customer.

The complementary nature of these mental models is reflected in rich data from Team A participants:

Team A product owner:



“I was actually quite amazed by the team. They work together very well. What we had here were a bunch of people who knew what they were talking about and didn’t say anything unless they were really clear on what they were saying. It was all very thought through. There was a real personality type where they listened well and were respectful of each other’s knowledge. They listened very carefully to each other, and listened to what I wanted to achieve with this app.”

Team A Scrum master:

“The product owner was fully committed. He just wanted to be involved, and this development was like his baby, so he had skin in the game. He would come to every stand-up. He wanted to understand our issues that we came across, so he wasn’t just saying, ‘Oh, I don’t care, just deliver me the product.’”

Team A development team member:

“The product owner was so engaged. He became part of our team, and he saw how we operate, it was great. He was really, really pleased with the outcome...The one thing I learned from all this is that the product owner can make it or break it. It doesn’t matter how enthusiastic we are, if the product owner does not engage either with us or with the rest of the organisation, then we’re set up to fail.”

## 4.2 Individual ISD project mental models

**Product Owner:** For product owners, the team with the highest self-reported positive evaluation had a product owner with a primary Team mental model and a secondary Customer mental model. The data analysis indicates that Team A product owner had a strong working relationship with the Scrum master and development team.

In Team B, the product owner had a primarily Customer mental model, with a secondary Team mental model. This product owner had the same rating for positive Scrum outcomes as the product owner for Team A, but the team’s rating was slightly lower. This may be due to the focus on Customer over Team. However, whether this is a negative aspect depends on how the reader views the importance of team satisfaction. In some cases, this may still be considered a particularly successful project, because the client was satisfied with the outcome.

In Team C, the product owner had a primarily Enterprise mental model, with a secondary Team mental model. This absence of Customer mental model contrasts with the other product owners. In the rich data, the product owner from Team C was particularly focused on following a process to deliver the product. According to the Scrum master, this product owner was also less engaged with both the Team (not always available to answer questions), and with the wider Customer base. In some cases, customers were bypassing the product owner and approaching the project team directly with requirements.

Based on the analysis of product owner mental models, Team and Customer mental models appear to be of most value for a successful Scrum sprint. The presence of the Enterprise mental model type does not appear to have benefited the project. No information is available for the Product mental model type, because this was not strongly exhibited by participants.

**Scrum Master:** Both Scrum masters had the same mental models, and yet the self-reported client and team evaluation differed widely. In particular, Teams A and C had the same Scrum master, but the self-reported team satisfaction differed between High for Team A and Low for Team C.

It could be argued that this means the Scrum master mental model is not relevant to positive Scrum evaluation. Evidence of this also appears in the rich data: All non-product owner participants mentioned the product owner during their interviews. Only one non-Scrum master participant mentioned the Scrum master during their interview. The remainder of the participants in this research did not mention the Scrum master in their interviews at all. Further research and follow up is required to determine how the Scrum master fits into the Scrum mental model dynamic.

**Development Team:** The developers with the highest self-reported positive outcomes both belonged to Team A and both had a mental model of Customer followed by Team. However, the rich data suggests that this is due to the product owner’s interaction with the team. These complementary mental models are discussed in the next section.

The developer with the lowest self-reported positive evaluation (Team C) had a mental model type of Team followed by Enterprise. One could argue that the presence of the Enterprise mental model does not align with the Agile manifesto values – in particular, Individuals and Interactions over Processes and Tools (Beck et al., 2001). Concepts that focus on processes are most aligned in the Enterprise mental model type. This could lead to disenchantment with a Scrum scenario, but in the case of this research, we do not have enough data to be able to tell. This is because the Team C developer was not certain about what they were supposed to be doing (“It was scary”), and therefore may have had an incomplete Scrum mental model.

### **4.3 Team mental model**

The complementary nature of the mental models between the product owner and development team in Team A appeared to be a driving factor in self-reported positive outcomes. A sense of mutual respect was apparent. In Team C, the product owner did have a similar mental model to one of the participants, and yet Team C self-reported the lowest satisfaction. In Team B, the product owner and development team had shared mental models but did not report the same levels of satisfaction or speak as positively about the outcome of their Scrum project or individual Scrum sprints. This contrasts with the expected outcome based on the literature review, that shared mental models would drive the highest satisfaction. Instead, it appears that complementary mental models are more important for higher satisfaction outcomes.

## **5 Contributions and Implications**

The implications of this study should be considered in light of its limitations. Our study is limited by the number of cases, particularly for less successful Scrum projects. A literal replication (Yin 2009) therefore cannot be used to provide stronger evidence to the results. Additionally, smaller teams were selected for a practical reason. We would like to know most team members’ mental models and how they contribute to Scrum success. Smaller project teams may not completely reflect large project teams in public sectors. However, smaller teams represent those government projects dealing with at least a moderate level of technical and organisational complexity (Xia and Lee 2004) and provide service to a few hundreds of users. Such type of projects accounts for a considerable proportion of projects in New Zealand government. Furthermore, it is suggested that in order to scale Scrum in large organisations, modularity has been one of the successful strategies (Sutherland 2019). Success of small sub-Scrum teams is a cornerstone for a large Scrum team. Therefore, despite the limitations related to generalisation, this research provides examples of successful Scrum delivery for small Scrum teams in the public sector. The findings offer preliminary evidence regarding the importance of the product owner role within Scrum, as well as insight into how a complementary mental model between a product owner and a development team contributes to self-reported positive outcomes.

Practitioners who are responsible for managing Scrum cannot underestimate the importance of the product owner for Scrum success. Practitioners, particularly product owners and development team members, can also use the Scrum mental model as a blueprint at an individual level for personal development and learning, with a focus on Team and Customer mental models that align with the principles of the Agile Manifesto. Nuottila et al. (2016) found that training is essential for Agile personnel to have a full understanding of the value of Agile methods in public organisations. Understanding the agile methods, and the changes that come with these methods, is vital as it will give personnel the motivation to accept and follow the change. The findings show that people and their socio-psychological factors are critical to the success of Agile methods in public organisations. The public sector may consider the bottom-up approach to gradually shift individual mental models to promote organisational agility in the public sector.

This research contributes to IS knowledge by providing insight into the mental models that foster self-reported positive Scrum outcomes, particularly for the critical product owner role. We also open discussion about what constitutes an effective team mental models – shared or complementary. Our findings are not conclusive, but illustrated a potential application of the ISD project mental model to assess team members’ minds in a Scrum environment.

## **6 Conclusion**

This research provides insight into the mental models that drive self-reported positive Scrum outcomes, and provoke practitioners to reflect on, when forming Scrum teams, how the mental models of different team members may align. The complementary nature of mental models between the

product owner and the development can be considered. For academics, this research highlights the applicability of the ISD project mental model and illustrates that the Customer and Team mental models matter in Scrum teams.

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